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**Title: System and Method for Publishing,
Updating, Navigating, and
Searching Documents Containing
Digital Video Data**

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Title: System and Method for Publishing, Updating, Navigating, and Searching Documents Containing Digital Video Data

FIELD OF THE INVENTION

5 **[0001]** This invention relates generally to multimedia documents comprising digital video data. More specifically, this invention relates to a system and method for adapting multimedia documents having a hierarchical structure for use in various computer and web-based applications.

10 **BACKGROUND OF THE INVENTION**

[0002] Advances in data networking and computing equipment technology have permitted greater flexibility in the use of digital video technology in computer and web-based applications. In particular, a demand exists for multimedia applications (i.e., applications which support a variety of
15 media formats including digital video, audio, graphics, text, etc.) which can be accessed by a user over the Internet using a web browser.

[0003] A multimedia document comprising digital video data can be used to generate a multimedia presentation to a user for viewing. These
20 multimedia documents (i.e. "movies") typically contain digital video data in the form of a video data stream or series of video frames, and an audio data stream or audio track to be synchronized with the video data and played during the display of video data. Such multimedia documents comprising digital video data, audio data, and optionally other data stored in serial format
25 have been used in a variety of prior art applications designed to facilitate the viewing, browsing and manipulating of the contents of the multimedia documents.

[0004] U.S. Patent Number 5,521,841 issued to Arman et al. discloses
30 a method for allowing the user to rapidly browse a video sequence by pre-processing the linear video sequence of frames to detect scene changes, and

constructing a series of frames representative of multiple images within the video sequence for viewing by a user.

[0005] U.S. Patent Number 5,682,326 issued to Klingler et al. discloses
5 a system for displaying various multimedia elements including video and
audio data, transitions, and special effects in a multi-window environment
where a user can edit a digital movie. In one window, digitized video clips (i.e.
source clips) or more specifically, references to portions thereof (i.e. reference
clips) are represented as a set of multiple linear tracks, each track being
10 associated with the data of a specific multimedia element.

[0006] U.S. Patent Number 5,821,945 issued to Yeo et al. discloses a
method for decomposing a linear sequence of video frames into groups of
frames, and representing each group of frames as a node in a graph
15 displayed to a user to facilitate the browsing of the video frames. A series of
mathematical algorithms are used to determine related video frames from the
sequence, and each group of related video frames is represented as a node
in a hierarchical "scene transition" graph.

20 **[0007]** U.S. Patent Number 5,884,056 issued to Steele discloses a
web-based system and method for browsing a series of frames stored in a
video data object. The system permits a user to browse a sequence of
thumbnail representations of selected frames within the series. The user can
make a request to view intermediate frames between two selected frames in
25 the sequence, resulting in the display of a new sequence of thumbnail
representations of frames within the series of intermediate frames. This
request can be repeated on the new sequence, allowing a user to examine
any part of any displayed sequence in greater detail.

[0008] U.S. Patent Number 5,995,095 issued to Ratakonda discloses a method for processing a digital video signal for a digital video sequence, and subsequently generating a summary of the video sequence from selected frames in the sequence at different levels of summary detail using a hierarchical model. Selecting a frame for browsing at the most detailed summary level results in the playback of a segment of the actual video sequence.

[0009] U.S. Patent Number 6,006,241 issued to Purnaveja et al. discloses a method for generating an annotation stream of text and/or graphical data, the output of which can be synchronized to the display of video data on a web page.

[0010] U.S. Patent Number 6,026,389 issued to Nakajima et al. discloses a system which allows a sequence of frames of a motion picture to be rapidly browsed in a web browser. A Macro Browser window is used to browse the sequence in larger "macro" increments, while a Micro Browser window is used to query images at a higher level of detail, in smaller "micro" increments.

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[0011] U.S. Patent Number 6,115,035 issued to Compton et al. discloses a system and method for translating analog audio and video signals into digital signal segments, and to archive and distribute these digital signal segments to a web server.

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[0012] Unfortunately, many of the above prior art systems and methods require significant subsequent processing of the digital video data in multimedia documents (which is typically stored in the form of a linear sequence of frames) after the documents have been created to convert the

data into a form suitable for use in the desired application (e.g., browsing, editing, etc.).

SUMMARY OF THE INVENTION

5 **[0013]** The present invention relates to a system and method for publishing, updating, navigating, and searching multimedia documents having a hierarchical structure and comprising digital data.

10 **[0014]** One aspect of the present invention is directed to a system and method for searching a multimedia document, wherein the method comprises the steps of performing a search of the text data in the multimedia document according to a user-defined query, and displaying the results of the search.

15 **[0015]** Another aspect of the present invention is directed to a system and method of using digital video data to answer frequently asked questions, wherein digital video data associated with an answer to a user-selected frequently asked question is retrieved and outputted to the user.

20 **[0016]** Another aspect of the present invention is directed to a system and method for publishing multimedia documents, wherein the method comprises the steps of creating a movie from a multimedia document, partitioning the movie into multiple movie components, and generating one or more output documents capable of being processed by a web browser for viewing by a user, whereby a user can receive output from movie components
25 as selected by the user.

[0017] Another aspect of the present invention is directed to a system and method for navigating multimedia documents, wherein the method comprises the steps of creating a navigation index for the multimedia

document, retrieving data from the multimedia document based on a user-selected index element in the navigation index, and outputting the retrieved data.

- 5 **[0018]** Another aspect of the present invention is directed to a system and method for updating multimedia documents, wherein the method comprises the steps of retrieving data from a selected structural element of the multimedia document, modifying the data, and storing the modified data in the structural element of the multimedia document.

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BRIEF DESCRIPTION OF THE DRAWINGS

[0019] For a better understanding of the present invention and to show more clearly how it may be carried into effect, reference will now be made by way of example, to the accompanying drawings which show a preferred embodiment of the invention, and in which:

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[0020] Figure 1 illustrates the hierarchical structure of a multimedia document;

- 20 **[0021]** Figure 2 illustrates data elements which may be found in a multimedia document;

[0022] Figure 3 is a screenshot from a prior art application which uses a multimedia document having a hierarchical structure;

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[0023] Figure 4A is a schematic diagram illustrating a system for searching a multimedia document having a hierarchical structure;

[0024] Figure 4B is a flowchart illustrating the steps in a method of searching a multimedia document having a hierarchical structure;

[0025] Figure 5A is a schematic diagram illustrating a system for using
5 digital video data in answering frequently asked questions;

[0026] Figure 5B is a flowchart illustrating the steps in a method of using digital video data in answering frequently asked questions;

10 **[0027]** Figure 6A is a schematic diagram illustrating a system for publishing multimedia documents to the web;

[0028] Figure 6B is a flowchart illustrating the steps in a method of publishing multimedia documents to the web;

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[0029] Figure 7 is a screenshot illustrating a web page with a table of contents generated from a system for publishing multimedia documents to the web;

20 **[0030]** Figure 8 is a screenshot illustrating a web page with thumbnail graphics in a “visual tree” format generated from a system for publishing multimedia documents to the web;

[0031] Figure 9A is a schematic diagram illustrating a system for
25 navigating a multimedia document having a hierarchical structure;

[0032] Figure 9B is a flowchart illustrating the steps in a method of navigating a multimedia document having a hierarchical structure;

[0033] Figure 10A is a schematic diagram illustrating a system for
5 updating a multimedia document having a hierarchical structure; and

[0034] Figure 10B is a flowchart illustrating the steps in a method of updating a multimedia document having a hierarchical structure.

10 **DETAILED DESCRIPTION OF THE INVENTION**

[0035] The present invention relates to a system and method for representing multimedia documents containing a variety of multimedia elements including digital video data in a format suitable for use in various applications. In particular, the present invention relates to applications which
15 use multimedia documents that have been created having a hierarchical structure.

[0036] Advantageously, the hierarchical structure allows the contents of the multimedia documents to be manipulated as modular units for use in a
20 wide variety of applications. This method of representing multimedia documents comprising digital video data has been described in Baecker, R.M. et al., A Multimedia System for Authoring Motion Pictures, Proceedings of ACM Multimedia '96, 31-42, and Rosenthal, A.J. and Baecker, R.M., Multimedia for Authoring Motion Pictures, Proceedings Graphics Interface '94,
25 133-140, for example.

[0037] Referring to Figure 1, the structure of a typical multimedia document having a hierarchical structure is shown generally as 10. Although conceptually, as described herein, the multimedia document 10 has a

hierarchical structure, physically the multimedia document 10 consists of multiple files. Some of these files are documents that define the framework of the multimedia document 10, while other files store the actual data of which the multimedia document 10 is comprised. The documents that define the framework of the multimedia document 10 can be written in Structured Multimedia Production Language (SMPL), a variant of Extensible Markup Language (XML) devised by the assignee of the present invention. In variant embodiments of the present invention, the documents that define the framework of the multimedia document 10 can be expressed in other languages, such as Structured Multimedia Integration Language (SMIL), for example.

[0038] The structure of the multimedia document 10 is defined by numerous structural elements 15 linked together in a hierarchical or tree-like model. A structural element 15 is a data structure that contains a list of lower-level structural elements, and optionally, data. Preferably, these structural elements 15 are given designations such as movie, act, scene, and shot in the manner of a Hollywood-style script, although different designations may be defined. At the highest level of the hierarchy, the multimedia document 10 can be represented as a structural element 15 designated as a movie 20. The movie 20 is comprised of multiple structural elements 15 of lesser size, designated as acts 30. Similarly, each act 30 is comprised of one or more structural elements 15 designated as scenes 40, and each scene 40 comprises one or more structural elements 15 designated as shots 50. Each shot 50 contains multimedia data 60. In variant embodiments of the invention, higher-level structural elements such as acts 30 or scenes 40 may also contain multimedia data 60.

[0039] Referring to Figure 2, the lowest level structural element 15 of the multimedia document 10, which in the embodiment illustrated in Figure 1 is designated as a shot 50, stores the multimedia data 60 of the multimedia

document 10. The data 60 can be stored in various types of elements, including text elements 65 and content elements 70.

[0040] Optionally, higher-level structural elements 50 of the multimedia document 10 may also comprise text elements 65 and/or content elements 70.

[0041] Text elements 65 store descriptive data related to the associated shot 50, in text format. Text elements 65 can include, for example, a slug line 72 and an action description 74. The data 60 for the associated shot 50 can also be stored in content elements 70 which contain multimedia data in various formats. Each content element 70 contains timing information as well as other descriptive information relating to the multimedia data stored in the particular content element 70. The multimedia data of each content element 70 is classified according to its purpose or “treatment”. Treatments may include, for example, voiceover 75, music 76, sound effects 77, live video 78, synthetic video (not shown), title 79, and transition (not shown).

[0042] Content elements 70 may also be classified as external or internal. An external content element is a reference to a digital representation of sound and/or video, and is typically stored in the form of a movie file, image file or a sound file. An internal content element contains text that can be either descriptive in nature (e.g., annotation, dialogue, director’s notes) or functional in nature (e.g., transitions, effects).

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[0043] In summary, the multimedia document 10 is represented as a hierarchical data structure, which is initialized and populated during the process of creating the multimedia document 10. During the creation process, an author of the multimedia document 10 indicates the role of each structural element 15, text element 65, and content element 70, and provides

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descriptive information pertaining to those elements. In particular, the addition of descriptive information to digital video is not done after the fact, as in prior art video annotation processes. In the present invention, the inclusion of descriptive data in a multimedia document 10 is an integral part of the authoring or creation process, permitting the data 60 in a multimedia document 10 to be used in a variety of applications, and allowing the data 60 in the multimedia document 10 to be modified without requiring the structure of the multimedia document 10 to be significantly changed.

10 **[0044]** For example, referring to Figure 3, a screenshot of a prior art video application which displays data 60 in a multimedia document 10 having a hierarchical structure, is shown generally as 90. This application facilitates the creation and inspection of multimedia documents 10 by displaying, for example, a movie title 91, scene titles 92, scene notes 93, shot titles 94, shot
15 descriptions 95, timing information 96, and graphic thumbnail images 97.

[0045] Referring to Figure 4A, a system for searching a multimedia document 10 having a hierarchical structure, designed in accordance with the present invention, is shown generally as 100. Search system 100 is a further
20 example of an application that utilizes the features of multimedia documents 10 having a hierarchical structure. Search system 100 searches text data stored in text elements 65 and content elements 70 of a multimedia document 10 using text-based search engines or search tools 110 as is known, or customized search engines or search tools (not shown) designed to search
25 and/or index the text data stored in a multimedia document 10. The search tools 110 may exist as part of a software application executing on a personal computer (PC) 130, for example. Search tools 110 that accept user-defined queries entered through an input device 135 can be used to search the text data of the multimedia document 10. The results of the search can then be
30 displayed to a user through an output device 140 connected to the PC 130. Output device 140 may be a web browser, for example. Alternatively, the

search results may be transmitted to another application module (not shown) for subsequent processing.

[0046] Optionally, text data in the multimedia document 10 can be
5 stored in a database (not shown).

[0047] Referring to Figure 4B, a method of searching a multimedia document 10 having a hierarchical structure is shown generally as 150 and commences at step 160.

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[0048] At step 162, the text data in the multimedia document 10 is searched using search tools 110, preferably according to a user-defined query provided through input device 135.

15 **[0049]** At step 164, results obtained from the search performed at step 162 are displayed to a user through an output device 140, such as a web browser. In variant embodiments of the invention, the results of the search performed at step 162 may be transmitted to another application module for subsequent processing at step 164.

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[0050] Step 166 marks the end of the method for searching a multimedia document 10 having a hierarchical structure.

25 **[0051]** The system 100 of Figure 4A and the method 150 of Figure 4B for searching a multimedia document 10 having a hierarchical structure have the advantage of allowing text to be searched more efficiently as compared to other systems and methods for searching video documents that require significant processing of the video documents into a text format after the

creation of those video documents. The processing may include, for example, manual text extraction or annotation of the video documents, or the application of voice recognition algorithms to convert the video documents into text.

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[0052] Referring to Figure 5A, a system for using digital video data to answer frequently asked questions, designed in accordance with the present invention, is shown generally as 170. System 170 is another example of an application that utilizes the features of multimedia documents 10 having a hierarchical structure. Answers to a user-selected frequently asked question selected from a set of frequently asked questions (FAQ) displayed to a user on a web page, can be presented to the user using digital video data stored in a multimedia document 10. Preferably, the answers to a user-selected frequently asked question is displayed to the user in a web browser.

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[0053] More specifically, the system 170 comprises a database 175 for storing digital video data of the multimedia document 10. An output device 180 (e.g., web browser) is connected to a server 185 comprising a FAQ module 188 for displaying a document 189 of frequently asked questions to a user. The FAQ module 188 then receives input from the user through input device 190 identifying a user-selected frequently asked question contained in the document 189. A retrieval module 192 retrieves data, including digital video data, associated with the answer to the user-selected frequently asked question from the database 175, and outputs the data to the user through the output device 180. FAQ module 188 and retrieval module 192 can reside on the same server 185 or on different servers.

[0054] Referring to Figure 5B, a method of using digital video data to answer frequently asked questions is shown generally as 192, and commences at step 193.

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[0055] At step 194, a multimedia document 10 having a hierarchical structure is created which contains data, including digital video data, that can be used to provide answers to frequently asked questions displayed on a web page.

[0056] At step 195, a document 189 containing frequently asked questions is displayed to a user on a web page.

[0057] At step 196, input is received from the user. The input identifies a user-selected frequently asked question contained in the document 189.

[0058] At step 197, data in the multimedia document 10 associated with an answer to the user-selected frequently asked question is retrieved from the database 175.

[0059] At step 198, data retrieved at step 197 is outputted to the user through an output device 180. Alternatively, the data can be directed to another application module for further processing before being outputted to the user.

[0060] Step 199 marks the end of the method of using digital video data to answer frequently asked questions.

[0061] The system 170 of Figure 5A and the method 192 of Figure 5B for using digital video data to answer frequently asked questions advantageously permit users to be shown how to perform tasks, for example, using motion pictures. This can be more effective than other systems and

methods for answering frequently asked questions that are solely text-based, as the use of digital video data can facilitate greater understanding of the answers. Further, the method 192 of using digital video data to answer frequently asked questions can be more engaging to the user than methods
5 which only use text to answer frequently asked questions.

[0062] In accordance with the present invention, the multimedia document 10 having a hierarchical structure may also be published or exported to the web, whereby a collection of web pages constituting a
10 complete Internet web site can be generated from the multimedia document 10. Publishing multimedia documents to the web allows media-rich web sites to be created, and makes it possible for users to explore a complex multimedia document using a standard web interface which they will already be familiar with. Advantageously, since the data in the multimedia document
15 10 is already highly modular and arranged in a hierarchical structure, it is possible for the user to view desired portions of the multimedia document 10 as a movie presentation, without having to download the entire movie. Thus, segments of a multimedia document 10 can be quickly accessed by a user, while the download time required is minimized. This can be particularly
20 advantageous where the multimedia document 10 is large and where the speed at which data can be downloaded to a user's computer is limited.

[0063] Referring to Figure 6A, a system for publishing multimedia documents to the web is shown generally as 200. Publishing system 200
25 comprises an authoring workstation 210 in which the files associated with a multimedia document 10 having a hierarchical structure are stored. A creator application 215 can be executed by a user to create a movie representation of a multimedia document 10. A publishing application module 220 can be executed to publish the multimedia document 10 to the web. More
30 specifically, the publishing application module 220 creates a collection of web pages 230 and associated data files 231 which will be used to display the

content of the multimedia document 10 to users. The web pages 230 and associated data files 231 can be stored on a web server 235. Web server software modules 238 also reside on web server 235. Web server software modules 238 control the operations of the web server 235 and the web pages 230 stored thereon.

[0064] The web pages 230 are created in HyperText Markup Language (HTML) in the preferred embodiment of the invention. The web pages 230 are created using a collection or bundle of document templates 240, wherein each document template 240 corresponds to one or more types of structural elements 15 defined in the SMPL-based multimedia document 10. The document template 240 is a document written in a modified form of HTML containing defined substitution tags. Substitution tags are markers within a document template 240 that describe how to transform information contained in structural elements 15 into ordinary HTML.

[0065] The web pages 230 are processed by a web browser 245 residing on a client PC 250 connected to the web server 235 through a network connection 260, preferably an Internet connection. Plug-in modules 265 capable of being used in conjunction with the web browser 245 may also reside on the client PC 250. Plug-in modules 265 are used to display data having different formats on the web browser 245. For example, the format of the web pages 230 or data files 231 being downloaded to a web browser 245 may be in one of the following formats which require decoding by a plug-in module 265: QuickTime, AVI, Windows Media, RealMedia.

[0066] Plug-in modules 265 may also be used to decompress data downloaded into the web browser 245 that has been previously compressed during the process of publishing the web pages 230.

[0067] Referring to Figure 6B, a method for publishing multimedia documents 10 to the web is shown generally as 300, and commences at step 310.

5 **[0068]** At step 320, an author creates a multimedia document 10 having a hierarchical structure, as depicted in Figures 1 and 2, for example.

[0069] At step 330, publishing application module 220 creates a playable QuickTime movie for the multimedia document 10. After an instance
10 of a QuickTime movie object is generated and initialized, the movie is created by recursively processing each structural element 15 in the multimedia document 10 as follows:

15 a) For each content element 70 directly associated with the structural element 15 being processed, zero or more tracks are generated with the appropriate media data and timing information for that content element 70. Each track includes a stored indication of the desired treatment based on the type of the content element 70. For example, if the content element 70
20 comprised the data of an imported audio file, a single track containing the audio data would be generated.

b) Each of the lower-level structural elements of the given structural element 15 is processed recursively in the same
25 fashion.

[0070] As a result, all content elements 70 of the multimedia document 10 will ultimately be processed and multiple sets of tracks will be created.

[0071] While in the preferred embodiment of the invention a QuickTime movie is created and processed, in variant embodiments of the invention, movies or documents of other formats may be used.

5 **[0072]** At step 340, the author selects one or more document templates (i.e. a document template bundle) from a selection of document templates 240.

10 **[0073]** At step 350, the author can select one or more desired output multimedia formats from a variety of available formats, so that media (data) files 231 and web pages 230 for the selected formats can be generated in the selected output multimedia formats. For example, available formats may include QuickTime, AVI, Windows Media, and Real Media. A default multimedia format may be defined and used in the event that no user
15 selection has been made.

[0074] At step 360, the QuickTime movie created at step 330 is processed by the publishing application module 220, for each output multimedia format selected at step 350, as follows:

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a) For each treatment (e.g. Live Video, Voiceover, etc.) found within the document, the author can select a compression algorithm to be used to the data in associated tracks. In variant embodiments of the invention, the publishing application
25 module 220 may be programmed to determine an optimal compression algorithm to be used for different treatments, based on pre-determined criteria (e.g. maximum compression, minimum compression time, etc.) Advantageously, the present invention permits different compression algorithms to be used

on different treatments. It is not necessary to use only one compression algorithm for compressing data in a given movie.

5 b) The movie is divided into several sub-movies based on the number of treatments.

10 c) Each sub-movie is compressed according to a compression algorithm selected in (a), if any, to generate an output sub-movie.

15 d) The output sub-movies are merged into an output movie.

20 e) The output movie is divided into movie components (i.e. "chunks") based on the timing of the structural elements in the multimedia document 10.

25 f) For each movie component, a JPEG thumbnail image can be generated.

30 **[0075]** As a result, the output movie will contain all the media in the QuickTime movie originally generated at step 330, but in a compressed form suitable for transmission over the Internet. The output movie has also been divided into movie components or chunks, to permit a user to load only a small portion of the movie, if desired. For instance, a user can view a specific scene of a specific act of the movie representation of the multimedia document 10, without having to download the entire output movie.

[0076] At step 370, HTML output files (i.e. web pages 230) are generated for each output format selected at step 350. This comprises the step of traversing the structural elements 15 of the multimedia document 10, processing each structural element 15 as follows:

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For each structural element 15, if there is a template within the template bundle that corresponds to the structural element 15:

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a) The template is first processed by searching for substitution tags in the template;

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b) For each substitution tag within the template, HTML code is generated based on the combination of substitution tags, the data content of the structural element 15, and the multimedia format being processed; Substitution tags are used to generate text, links to other HTML documents, embedded images, and references to movie components generated at step 360; and

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c) The resultant HTML document derived from the working of the template upon the structural element 15 is written out as an ordinary HTML file.

[0077] As a result, a collection of HTML files (i.e. web pages 230) and data files 231 (i.e. movie components and JPEG images) have been created.

25 This collection constitutes a complete web site representation of the original multimedia document 10. The web pages 230, movie components, and JPEG images can subsequently be stored on a web server 235 at step 380, and optionally integrated into an existing web site.

[0078] Step 390 marks the end of the method of publishing multimedia documents 10 to the web.

[0079] Upon loading the web pages 230 into a web browser 245, it may
5 be necessary to decompress compressed data before a movie component can be viewed by a user.

[0080] Depending on the template used, the visual appearance of the web pages will typically differ. For example, titles and/or other textual
10 descriptive information, and more generally, the contents of any text element 65 and/or content element 70 may be integrated into the web pages in a variety of layouts and styles.

[0081] For example, a web page 230 that incorporates titles in the
15 format of a table of contents as illustrated in Figure 7 can be generated by the present invention. A table of contents 395 can appear on the same page as a movie display 396 or in a separate frame within the web browser 245. The titles of the table of contents 395 can appear in the web page 230 as hyperlinks, which can be selected to permit the user to request output of one
20 or more movie components.

[0082] As a further example, a web page 230 that displays thumbnail graphic images in the form of a "visual tree" displayed in a web browser 245 as illustrated in Figure 8 can be generated by the present invention. By
25 clicking on a thumbnail graphic image 400 below the movie display 410, the movie component pertaining to a specified act, scene, or shot can be viewed in the movie display 410.

[0083] In variant embodiments of the invention, the method of the present invention may be embodied in a computer-readable medium or in a data stream.

5 **[0084]** In variant embodiments of the invention, an extension of the publishing system 200 can be implemented whereby "videograms" are supported. A specialized template bundle is used to generate a single page of HTML data that gives an overview of the multimedia document 10. This HTML page is then transmitted to a user as an electronic mail message (i.e. a
10 "videogram"). When the user receives the videogram, they will be able to select hypertext links within the message to view desired portions of a multimedia web site generated in accordance with the present invention.

[0085] In variant embodiments of the invention, "variant" elements may
15 be used within elements of a multimedia document 10 to facilitate the publishing of the multimedia document 10 to the web in different output formats. For example, a variant element can be a data structure containing sufficient information to permit web pages to be generated in several different languages (e.g. French and English). In this way, the same multimedia
20 document 10 can be used to publish several complete web sites, each being in a different language. Variant elements may also be designed to permit the publishing of multimedia documents 10 to the web for different operating systems, data transfer rates, or expertise levels (i.e. level of a user's computer knowledge), for example.

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[0086] In variant embodiments of the invention, the publishing system 200 may generate output documents in alternative formats. The HTML output from the publishing system 200 could be replaced with Structured Multimedia Integration Language (SMIL) documents, Wireless Markup Language
30 documents, or other types of Extensible Markup Language (XML) documents.

[0087] Referring to Figure 9A, a system for navigating a multimedia document 10 having a hierarchical structure, designed in accordance with the present invention, is shown generally as 420. Navigation system 420 is a further example of an application that utilizes the features of multimedia documents 10 having a hierarchical structure. Navigation system 420 uses a text processing module 422 for retrieving text data in a multimedia document 10 and creating a navigation index 425 that can be displayed to a user through an output device 428. The output device 428 can be, for example, a web browser. In that case, the navigation index 425 can be incorporated into a web page (not shown).

[0088] The navigation index 425 can be used by a user to quickly retrieve data in the multimedia document 10. The navigation index can be for example, in the form of a table of contents (e.g. as shown in Figure 7) or an index. The navigation index 425 comprises index components (not shown) which can be selected by a user, and which are associated with the data of a structural element 15 within the multimedia document 10. An index component, for example, can be a title or description associated with a specific structural element 15. A retrieval module 430 can retrieve data from the structural element 15 associated with an index component selected by the user through an input device 435. The data retrieved by the retrieval module 430 can be displayed to a user through the output device 428. The text processing module 422, navigation index 425 (or a document comprising a navigation index 425), and retrieval module 430 can reside, for example, on a server 440.

[0089] Referring to Figure 9B, a method of navigating a multimedia document 10 having a hierarchical structure is shown generally as 450 and commences at step 460.

[0090] At step 462, the text data in the multimedia document 10 is processed by the text processing module 422.

5 **[0091]** At step 464, a navigation index 425 such as a table of contents is created by the text processing module. The navigation index 425 can be incorporated into a document such as a web page, for example.

[0092] At step 466, a user selects an index element from the navigation index 425. The index element is associated with data of a structural element 15 in the multimedia document 10.

[0093] At step 468, the data of the structural element 15 with which the index element selected at step 466 is associated is retrieved by retrieval module 430. The retrieval module 430 may be programmed to retrieve only certain types of data (e.g., title only, video only, etc.) stored in that structural element 15.

[0094] At step 470, data retrieved by the retrieval module 430 at step 20 468 is displayed to a user.

[0095] Step 472 marks the end of the method for navigating a multimedia document 10 having a hierarchical structure.

25 **[0096]** The system 420 of Figure 9A and the method 450 of Figure 9B for navigating a multimedia document 10 having a hierarchical structure have the advantage of allowing a user to browse a compact outline view of a complex video document, in order to select data that the user desires to view

without requiring the entire multimedia document 10 to be searched, and without requiring the user to construct or guess search terms that may be required to retrieve the desired data.

- 5 **[0097]** Referring to Figure 10A, a system for updating a multimedia document 10 having a hierarchical structure, designed in accordance with the present invention, is shown generally as 480. System 480 is a further example of an application that utilizes the features of multimedia documents 10 having a hierarchical structure. System 480 allows data stored in text
10 elements 65 and content elements 70 of the multimedia document 10 to be updated, utilizing the benefits of the hierarchical structure of multimedia document 10. The data may be updated by a retrieval module 482 residing on a PC 484. Retrieval module 482 facilitates the retrieval of data stored in a multimedia document 10, and can display the data in an output device 485.
15 Through an input device 486, a user can select a structural element 15 containing data that the user wishes to edit. Update module 488, also residing on PC 484, can accept modifications of the data retrieved by retrieval module 482 from the user, and can store the modified data in the selected structural element 15 of the multimedia document 10. The data retrieved by the
20 retrieval module 482 can be modified by changing the data, adding data to the data retrieved by the retrieval module 482, and/or deleting data from the data retrieved by the retrieval module 482.

- [0098]** Referring to Figure 10B, a method of updating a multimedia
25 document 10 having a hierarchical structure is shown generally as 490 and commences at step 491.

[0099] At step 492, a user selects a structural element 15 which contains data that the user may wish to modify.

[0100] At step 494, retrieval module 482 retrieves data for that structural element 15 from the multimedia document 10, and displays that data to the user. This may require the hierarchy of the multimedia document 10 to be traversed and searched to locate the desired structural element 15.

- 5 Different traversal and search algorithms as known may be used for this purpose.

[0101] At step 496, optionally, the user makes modifications to the data. Modifications to the data (e.g., changes, additions, deletions) are
10 submitted to the update module 488 through an input device 486.

[0102] At step 498, the update module 488 stores the modifications to the data in the structural element 15 selected at step 492.

- 15 **[0103]** Step 500 marks the end of the method for updating a multimedia document 10 having a hierarchical structure.

[0104] In variant embodiments of the system 480 and method 490 for updating a multimedia document 10, various techniques for facilitating more
20 efficient updating of data as known in the prior art (e.g. tracking dirty data, caching techniques, etc.) can be employed.

[0105] In variant embodiments of the system 480 and method 490 for updating a multimedia document 10, a user is not limited to selecting one
25 specific structural element 15, but instead, the user can select a specific text element 65 or content element 70 for editing, or alternatively, multiple structural elements 15 for editing.

[0106] The system 480 of Figure 10A and the method 490 of Figure 10B for updating a multimedia document 10 having a hierarchical structure have the advantage of allowing modifications to be made to multimedia documents containing digital video data (e.g., movies) more efficiently in some instances, particularly if the desired changes are simple and only require the modification of data for a specific low-level component (e.g. changes to the data of a single voiceover 75 in a shot 50 or a single image). The modular nature of the multimedia document 10 having a hierarchical structure can be advantageously utilized to permit changes to be made without requiring data in other structural elements to be accessed or retrieved.

[0107] In variant embodiments of the invention, because the multimedia document 10 has a hierarchical or tree-like structure, multiple authors may work simultaneously to create or modify different structural elements within a document. Each author would make changes to particular nodes in the tree-like structure of the multimedia document 10, which could then be merged into the main tree-like structure using existing XML tools.

[0108] In variant embodiments of the invention, other applications using a multimedia document 10 having a hierarchical structure are possible.

[0109] With respect to the elements of the systems described in this specification, it will be apparent to those skilled in the art that the execution of various tasks need not be performed by the particular component specified in the description of the preferred embodiment of the invention. It will also be apparent to those skilled in the art that the components of these systems need not reside on the specific computing machine or device as described in this specification, and need not be implemented in the specific manner as described in the specification. For example, the components of the systems may physically reside on a single computing device, or may be distributed

across multiple computing devices. Data stored in databases may be stored in a single database, or distributed across several databases or other storage means. The connections in the systems can be maintained by any data communication means as is known, including Ethernet network connections, TCP/IP connections, wireless communication means, or other known connection means. The tasks performed by a particular module in these systems may instead be performed by multiple modules, or by a module different than that suggested in this specification.

- 10 **[0110]** As will be apparent to those skilled in the art, other variations, modifications and adaptations of the systems and methods described herein are possible without departing from the present invention, the scope of which is defined in the claims.